



George C. Marshall Space Flight Center  
Marshall Space Flight Center, Alabama 35812

ED27-ACU-FOP-006  
BASELINE  
8/9/99

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## **FACILITY OPERATING PROCEDURE**

**ED27 / Vibration, Acoustics, and  
Shock Team**

# **ACOUSTIC ABSORPTIVITY MEASUREMENTS**

**CHECK THE MASTER LIST—  
VERIFY THAT THIS IS THE CORRECT VERSION BEFORE USE**

ED27 / Vibration, Acoustics, and Shock Team		
Acoustic Absorptivity Measurements	ED27-ACU-FOP-006	Revision: Baseline
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## 1.0 INTRODUCTION

### 1.1 Purpose

The purpose of this procedure is to define the steps necessary to perform an acoustic absorptivity test using the Bruel and Kjaer Type 4002 Standing Wave Apparatus .

### 1.2 Scope

This document contains the procedure to conduct acoustic absorptivity tests.

## 2.0 SAFETY

### 2.1 Emergency Telephone Numbers

Emergency number for Fire or Ambulance - 911  
Security - 544-4357

### 2.2 Safety Considerations

There are no steps in this procedure with special safety considerations.

## 3.0 APPLICABLE DOCUMENTS

- Bruel and Kjaer Type 4002 Standing Wave Apparatus Instruction Manual, Revision March 1979
- ED27-OWI-003, Test Operation Procedure Preparation and Change Control

## 4.0 GENERAL REQUIREMENTS

- The Test Engineer will be in charge of all test preparations and activities.
- All changes to this procedure shall be done by the Test Engineer per ED27-OWI-003, Test Operation Procedure Preparation and Change Control.

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## 5.0 PRETEST PREPARATIONS

### 5.1 Instrumentation Calibration

All acoustic properties determined in this type of test are calculated with acoustic measurements which are relative to each other, and thus no calibration is required.

### 5.2 Required Equipment

5.2.1 Bruel and Kjaer Type 4002 Standing Wave Apparatus.

5.2.2 Function generator, Wavetek 395, or equivalent.

5.2.3 Portable voltmeter, Fluke 87, or equivalent.

5.2.4 Spectrum analyzer, Bruel and Kjaer 2133, or equivalent.

## 6.0 TEST MEASUREMENTS

### 6.1 Test Sequence

6.1.1 A sample of the substance to be tested must be cut into two circles to fit the two sample holders which are part of the 4002 apparatus. This can be done with scissors, x-acto knife, or any other convenient means.

6.1.2 Connect the function generator output to the 4002 input (speaker input).

6.1.3 Connect the voltmeter to the 4002 speaker to monitor speaker voltage.

NOTE: The speaker is rated at 6 watts and 4 ohms. Therefore, the speaker voltage should never be allowed to exceed 5 volts.

6.1.4 Connect the 4002 output (microphone output) to the spectrum analyzer.

6.1.5 Install the large circular sample in the large sample holder, and install the large tube on the 4002. Install the sample holder in the end of the tube.

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- 6.1.6 Set the output of the function generator to 100 Hz (sine wave) at 500 mV.
- 6.1.7 Position the 4002 trolley at 1 mm. Adjust the function generator output until an appreciable decibel level is reached at the microphone. Stay within the usable range of the speaker. Note this maximum decibel level.
- 6.1.8 Slowly move the 4002 trolley along the track, stopping at the position where the 100 Hz decibel level is a minimum. This may require “jockeying” the trolley back and forth in order to zero in on this point. Note this minimum decibel level, along with the distance in mm.
- 6.1.9 Repeat steps 6.1.6-6.1.8 for the 125, 160, 200, 250, 315, 400, 500, 630, and 800 Hz frequencies.
- 6.1.10 Install the small circular sample in the small sample holder, and install the small tube on the 4002. Install the sample holder in the end of the tube.
- 6.1.11 Set the output of the function generator to 1000 Hz (sine wave) at 500 mV.
- 6.1.12 Position the 4002 trolley at 1 mm. Adjust the function generator output until an appreciable decibel level is reached at the microphone. Stay within the usable range of the speaker.
- NOTE: Steps 6.1.13 and 6.1.14 may be done in reverse order, depending on whether the decibel level is rising or falling as the trolley is first moved.
- 6.1.13 Slowly move the 4002 trolley along the track, stopping at the position where the 100 Hz decibel level is a minimum. This may require “jockeying” the trolley back and forth in order to zero in on this point. Note this minimum decibel level, along with the distance in mm.
- 6.1.14 Slowly move the 4002 trolley along the track, stopping at the position where the 100 Hz decibel level is a maximum. This may require “jockeying” the trolley back and forth in order to zero in on this point. Note this maximum decibel level, along with the distance in mm.

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6.1.15 Repeat steps 6.1.11-6.1.14 for the 1250, 1600, 2000, 2500, 3150, 4000, 5000, and 6300 Hz frequencies.

## 6.2 Absorptivity Determination

6.2.1 Using the noted decibel data for each frequency, use the equations in the 4002 Instruction Manual to calculate the absorptivity coefficient. This will be a number between 0 and 1, with 0 meaning that the material is highly reflective at that frequency, and 1 meaning that the material is highly absorptive at that frequency.

6.2.2 If desired, the data collected in this procedure can be used to determine the acoustic impedance of the material. The 4002 Instruction Manual also contains the equations used for this calculation.